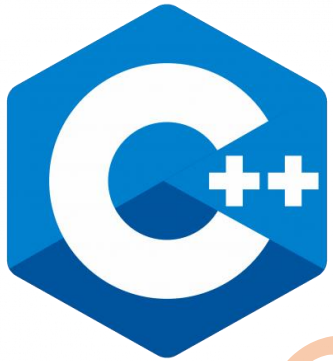

C++ Programming

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Object Oriented programming structure(oops) :-

-> It is a programing methodology to organise complex program into simple program in terms of class and objects such methodology is called as "Object Oriented programming structure"

-> It is a programing methodology to organise complex program into simple program by using the concept of Abstraction, Encapsulation
and Inheritance, modularity.

->so the language which supports Abstraction, Encapsulation and Inheritance is called as Object Oriented programming language.

Major pillars of oops

- **Abstraction**
  - getting only essential things and hiding unnecessary details is called as abstraction.
  - Abstraction always describe outer behavior of object.
  - In console application when we give call to function in to the main function , it represents the abstraction.
  - By Creating object and calling public member function on it we can achieve abstraction.
- **Encapsulation**
  - binding of data and code together is called as encapsulation. By defining class we can achieve encapsulation.
  - Implementation of abstraction is called encapsulation.
  - Encapsulation always describe inner behavior of object
  - Function call is abstraction and Function definition is encapsulation.
  - Information hiding
    - Hiding information from user is called information hiding.
    - In c++ we used access Specifier to provide information hiding.
- **Modularity**
  - Dividing programs into small modules for the purpose of simplicity is called modularity.
- **Hierarchy**
  - Hierarchy is ranking or ordering of abstractions.
  - Main purpose of hierarchy is to achieve re-usability.
  - Types –> 1: **Inheritance [is-a] , 2: Association [has-a]**

Minor pillars of oops

- **Polymorphism (Typing)**
  - One interface having multiple forms is called as polymorphism.
  - Polymorphism have two types
    1. **Compile time polymorphism (**Static polymorphism / Static binding / Early binding / Weak typing / False Polymorphism **)**

       when the call to the function resolved at compile time it is called as compile time polymorphism. And it is achieved by using function overloading, operator overloading, template
    2. **Runtime polymorphism (**Dynamic polymorphism / Dynamic binding / Late binding / Strong typing / True polymorphism**)**

       when the call to the function resolved at run time it is called as run time polymorphism. And it is achieved by using function overriding.
- **Concurrency**
  - Process of executing multiple tasks simultaneously is called Concurrency**.**
  - Can be achieved by multithreading which is Used to utilize hardware resources efficiently.
- **Persistence**
  - Used to maintain state of object across time and space on secondary storage .
  - Using file handling we can achieve it. To transfer and save the state of object needs serialization and also socket programming for network.

Association

- If has-a relationship exist between two types then we should use association.
- Example : Car has-a engine (OR engine is part-of car)
- If object is part-of / component of another object then it is called association.
- If we declare object of a class as a data member inside another class then it represents association.

Example Association:

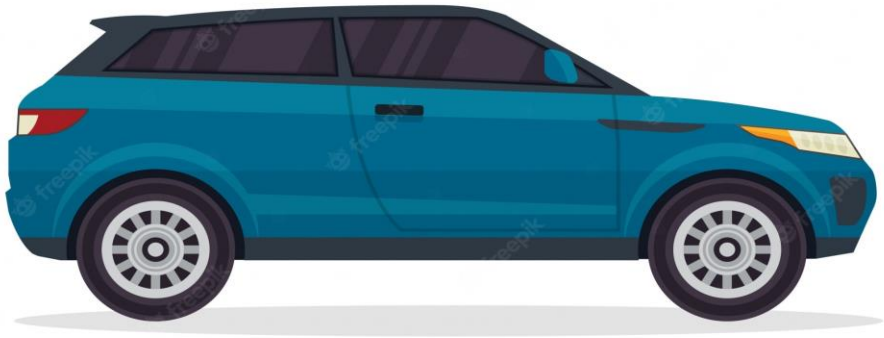
- Car has-a engine
- Laptop has-a hand disk
- Room has-a wall
- Bank has-a accounts

```
class Engine
{
        int cc, fuel;
};
class Car
{       private:
        Engine e;   //Association
};
```

Dependant Object : Car Object

Dependency Object : Engine Object

Example of Association



Composition and aggregation are specialized form of association

Composition

- If dependency object do not exist without Dependent object then it represents composition.
- Composition represents tight coupling.
- Example: Human has-a heart.

```
class Heart
{ };
class Human
{
   Heart hrt; //Association->Composition
};
```

Dependent Object : Human Object

Dependency Object : Heart Object

Aggregation

- If dependency object exist without Dependent object then it represents Aggregation.
- Aggregation represents loose coupling.
- Example: Department has-a Faculty.

```
class Faculty
{ };
class Department
{
   Faculty f; //Association->Aggregation
};
```

Dependent Object : Department Object

Dependency Object : Faculty Object

Inheritance

- If "is-a" relationship exist between two types then we should use inheritance.
- Inheritance is also called as " journey from Generalization to Specialization".
- Example: Book is-a product
- During inheritance, members of base class inherit into derived class.
- If we create object of derived class then non static data members declared in base class get space inside it.
- Size of object = sum of size of non static data members declared in base class and derived class.
- If we use private/protected/public keyword to control visibility of members of class by using access Specifier.
- If we use private/protected/public keyword to extend the class then it is called mode of inheritance.
- Default mode of inheritance is private.
  - Example: class Employee : person //is treated as class Employee : private Person
- Example: class Employee:public Person
- In all types of mode, private members inherit into derived class but we can not access it inside member function of derived class.

Syntax of inheritance in C++

class Person //Parent class { }; **class Employee : public Person //** Child class { };	In C++ Parent class is called as Base class and child class is called as derived class. To create derived class we should use colon(:) operator. As shown in this code, public is mode of inheritance.

class Person //Parent class
{ **char name[30]; int age;** };
class Employee : public Person //Child class
{ **int empid; float salary;** };
int main(void)
{
Person p;
cout<<**sizeof(p)<<endl;**
Employee emp;
cout<<**sizeof(emp)<<endl;**
return 0;
}
	If we create object of derived class, then all the non- static data member declared in base class & derived class get space inside it i.e. non-static. static data members of base class inherit into the derived class.

Except following functions, including nested class, all the members of base class, inherit into the derived class

- Constructor
- Destructor
- Copy constructor
- Assignment operator
- Friend function.

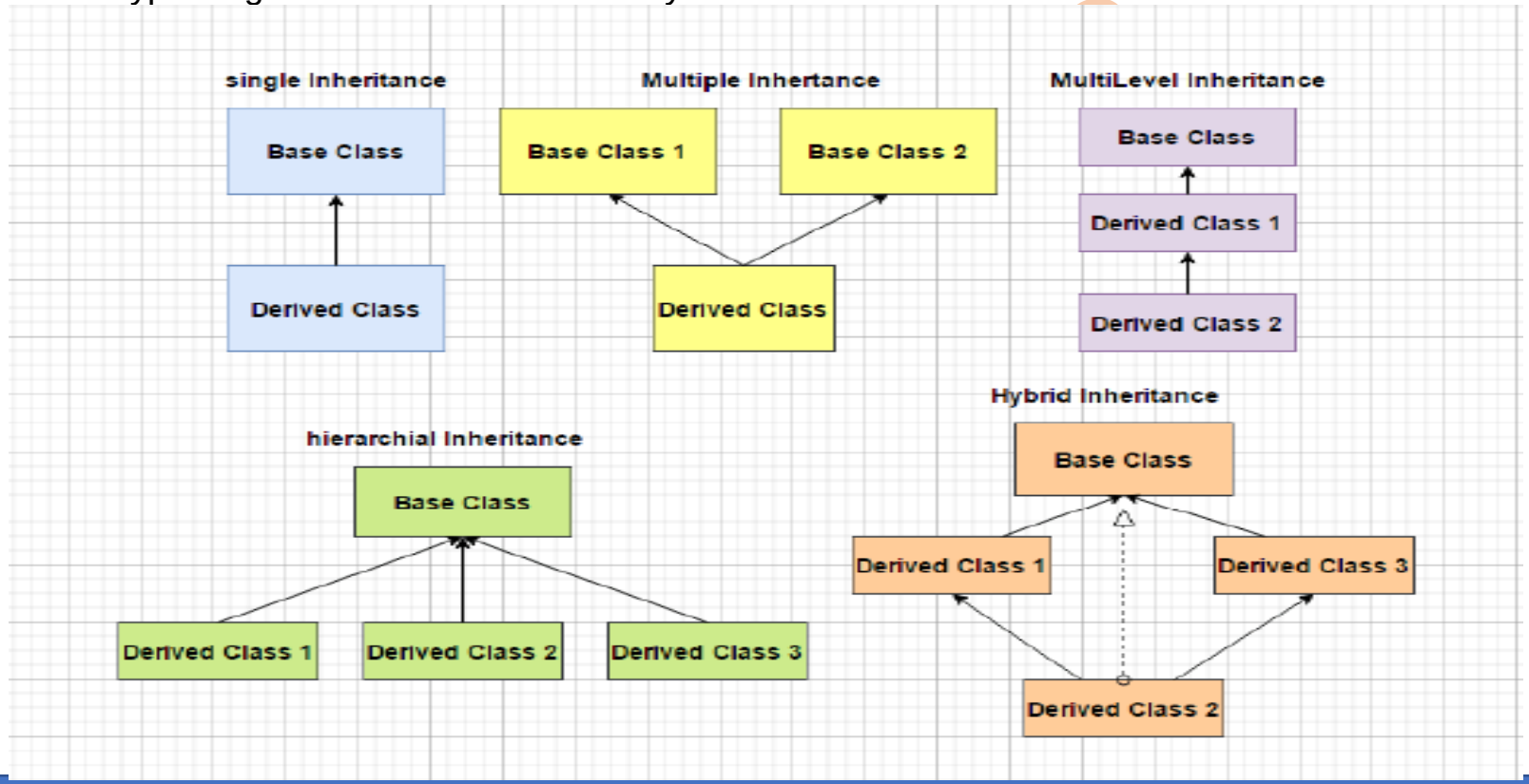
Protected Data member

- The protected access specifier allows the base class members to access onto derived class.
- However, protected members are not accessible from outside the class and global functions like main().
- Protected members in a class are similar to private members as they cannot be accessed from outside the class.
- But they can be accessed by derived classes or child classes while private members cannot.

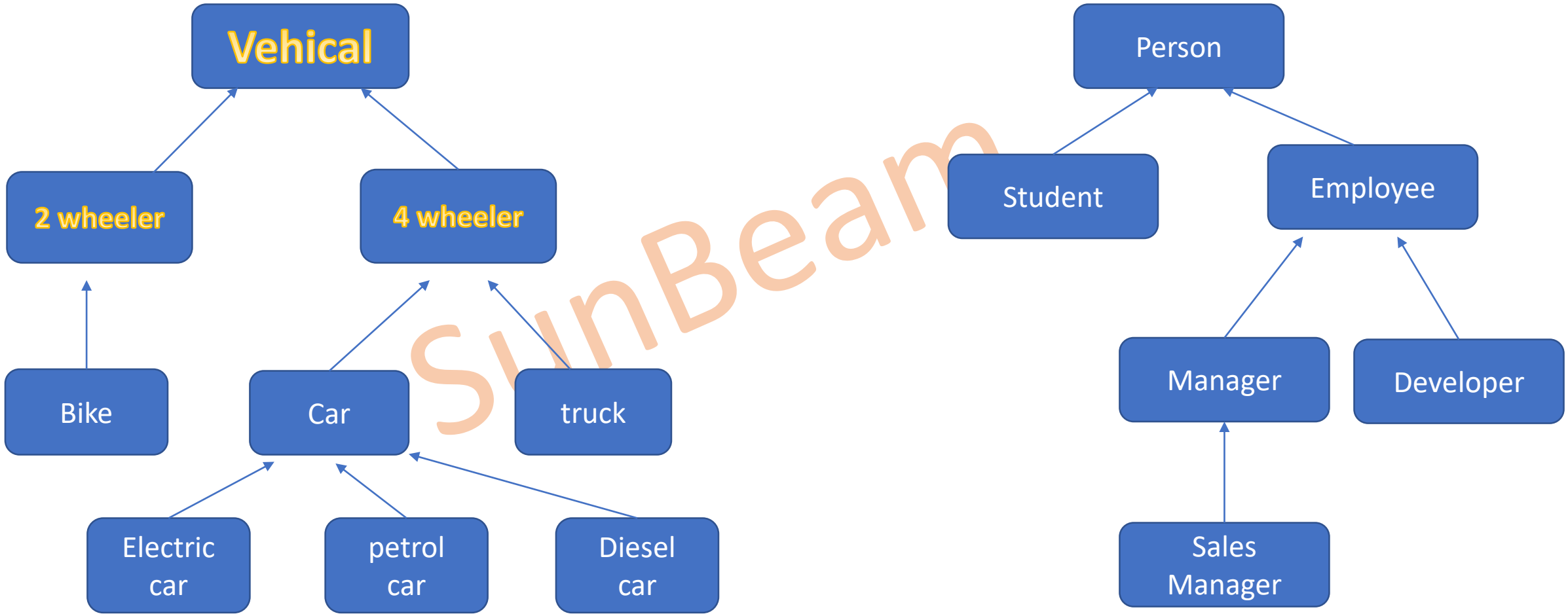
Types of Inheritance

- Single inheritance
- Multiple inheritance
- Hierarchical inheritance
- Multilevel inheritance

If we combine any two or more types together then it is called as hybrid inheritance.



Inheritance is also called as " journey from Generalization to Specialization".



BOOK	Inheritance	Product
Library	Association	Book
Rice	Inheritance	Food
Bowler	Inheritance	player
Mobile	Association	Charger

Mode of inheritance

- If we use private, protected and public keyword to manage visibility of the members of class then it is called as access specifier.
- But if we use these keywords to extends the class then it is called as mode of inheritance.
- C++ supports private, protected and public mode of inheritance. If we do not specify any mode, then default mode of inheritance is private.

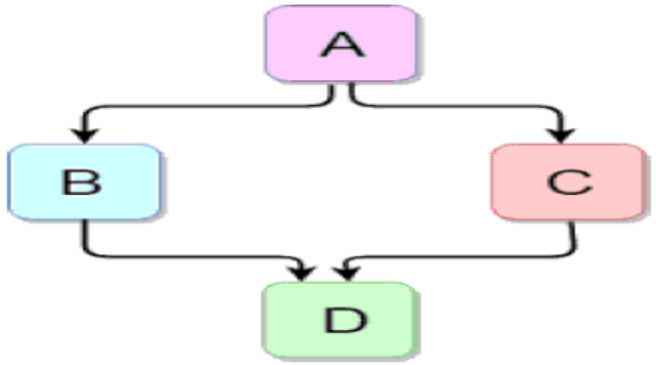
Mode of inheritance

Mode of inheritance (read "--->" as becomes)

	Base	Derived
public mode:		
	Public --->	Public
	protected --->	Protected
	private --->	NA
protected mode:		
	Public --->	Protected
	protected --->	Protected
	private --->	NA
private mode:		
	Public --->	private
	protected --->	private
	private --->	NA

Diamond Problem

- As shown in diagram it is hybrid inheritance. Its shape is like diamond hence it is also called as diamond inheritance.
- Data members of indirect base class inherit into the indirect derived class multiple times.
- Member functions of indirect base class inherit into indirect derived class multiple times. If we try to call member function of indirect base class on object of indirect derived class, then compiler generates ambiguity error.
- If we create object of indirect derived class, then constructor and destructor of indirect base class gets called multiple times.
- All above problems generated by hybrid inheritance is called diamond problem.



Solution to Diamond Problem– Virtual Base Class

- If we want to overcome diamond problem, then we should declare base class virtual i.e. we should derive class B & C from class A virtually. It is called virtual inheritance. In this case, members of class A will be inherited into B & C but it will not be inherited from B & C into class D.

```
class A { };
class B : virtual public A
{ };
class C : virtual public A
{ };
class D : public B, public C
{ };
```

Virtual Keyword

- **Virtual function** = It is the function which is called depending on type of object rather than type of pointer

- If class contains at least one virtual function then such class is called **polymorphic class**.

- If signature of base class and derived class member function is same and if function in base class is virtual then derived class member function is by default considered as virtual.

Function overriding.

Process of redefining, virtual function of base class, inside derived class with same signature is called function overriding.

- Virtual function redefined inside derived class is called overrided function.
- For function overriding:
    1. Functions must be exist inside base class and derived class.
    2. Signature of base class and derived function must be same.
    3. Function in base class must be virtual

Program Demo

Early Binding

create a class Base and Derived (void show() in both classes)

create base *bptr;

bptr=&d;

bptr->show()

Late Binding

create a class Base and Derived (void show() in both classes one as virtual in base class)

create base *bptr;

bptr=&d;

bptr->show()

Pure virtual function and Abstract class

- Virtual fun which is equated to zero such function is called as Pure virtual function
- Pure virtual function does not have body.
- A class which contains at least one Pure virtual function such class is called as "Abstract class".
- If class is Abstract we can not create object of that class but we can create pointer or reference of that class .
- It is not compulsory to override virtual function but It is compulsory to override Pure virtual function
- If we not override pure virtual function in derived class at that time derived class can be treated as abstract class.

Upcasting and downcasting

- Upcasting and downcasting :-

Upcasting - process of converting derived class pointer into base class pointer

or Storing address of derived class object into base class pointer.

eg : Person *p=new student();

Downcasting - process of converting base class pointer into derived class pointer

or storing address of base class object into derived class pointer

eg : Student *s=new person();

Thank You